Available online at www.sciencedirect.com

ScienceDirect

APCBEE Procedia 8 (2014) 348 – 353

Procedia APCBEE

www.elsevier.com/locate/procedia

2013 4th International Conference on Agriculture and Animal Science (CAAS 2013)
2013 3rd International Conference on Asia Agriculture and Animal (ICAAA 2013)

The Effects of Different Hormones and Their Doses on Rooting of Stem Cuttings in Anatolian Sage (*Salvia Fruticosa* Mill.)

A.Canan SAĞLAM [a,]*, Seviye YAVER[a], İsmet BAŞER[a], Latif CİNKILIÇ[b],

[a]*Namık Kemal Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü, Tekirdağ*
[b]*Namık Kemal Üniversitesi Çorlu meslek Yüksek Okulu, Tekirdağ*

Abstract

In this research, three different hormones and five different hormone dosages were applied on cuttings were taken from Anatolian sage plants (*Salvia fruticosa* Mill.) before flowering period. NAA, IBA (0, 60, 120, 180, 240 ppm) and IAA hormones (0, 100, 200, 300, 400 ppm) were prepared by dissolving in distilled water. Stem cuttings were kept in hormone solution for 24 hours and they were planted in perlit medium under greenhouse conditions. After a month, the number of rooted stem cutting, the number of root per stem cuttings, root length and root weight were determined on stem cuttings. Rooting was observed in all of the cuttings for both samples to which hormone was applied and to which hormone was not applied. According to the result of the variance analysis, the effects of the hormones and hormone doses on the examined characters were found significant as statistically. According to the results obtained, IAA application increased root number considerably. While high hormone dose applications caused the notable increase in root weight and root number in all of three hormones, low hormone applications did not affect root length.

Keywords: Sage, hormones, hormone doses, cutting, rooting

1. Introduction

Anatolia is the main centre of Salvia species in Asia, and its 89 species, half of which are endemic, were determined in Anatolia's natural vegetation. *Salvia fruticosa* Mill., being one of the commercial species with

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
E-mail address: nsaglam@nku.edu.tr.

doi:10.1016/j.apcbee.2014.03.052

its essential oil that is over %1, spreads in Mediterranean mainly in Turkey and Greece [1]-[4].

In Turkey, the leaves of Anatolian sage (*Salvia fruticosa* Mill.) are used instead of medical sage (*Salvia officinals* L.). Its leaves resemble medical sage's leaves in terms of chemical structure and treatment effects. Its essential oil has gastric, gastral, diuretic and saccharic effects. Externally, it can be used as wound healer and antiseptic [5] and [6]. In addition to these features, it is informed that it is among the plants of sage having the best antioxidant activity [7]. Along with internal consumption, sage (*Salvia fruticosa* Mill.) is gathered from natural vegetation from the west of Turkey and is exported being dry [8]. Related to the increasing export, efforts for the plant's production have increased in recent years.

Sage production can be made by the separation of secondary stems growing from seed, cutting and roots. Being an effective method in producing many plants, vegetative production with cuttings is seen as an attractive method for plant production industry [9]. Cuttings to which hormone is applied generally root much more rapidly than those to which hormones is not applied and construct a stronger root system, thus moulding in the lower parts of cuttings diminishes with accelerating of rooting. In their study they conducted with different species of Lamiaceae family, [10] detected the highest root height and root number values in *Salvia fruticosa* species in 3000 ppm IBA application for a period of 5 minutes.

In this study, it was aimed at determining the effects of different hormones and hormone doses in *S. fruticosa* cuttings upon the growth of seedling root.

2. Material and Method

In the research, Anatolian sage (*S. fruticosa* Mill.) grown in the previous years in the experiment fields of Namık Kemal University Agricultural Faculty Field Crops was used as material. In the premergence phase, for three different hormones and five different doses, totally 1875 cuttings including 125 cuttings peculiar to each dose were obtained by observing the plant growth. Cuttings were obtained in the form of 3-5 internodes in 12-15 cm length in the morning hours. In the doses in which NAA and IBA are 1. 0 , 2. 60, 3. 120, 4. 180, 5. 240 ppm, whereas IAA is 1. 0, 2. 100, 3. 200, 4. 300, 5. 400 ppm, they were prepared in pure water by dissolving in the laboratory. The obtained cuttings were planted in the greenhouse after being waited in the hormone solutions for 24 hours. The experiment was organised according to split parcels experimental design. In the greenhouses, pearlite was used as rooting environment. By unravelling cuttings after 30 days, number of rooted cutting, root number per cutting, root length and their weight were determined. In the assessment of the collected data, JMP statistical programme was used.

3. 3. Results and Discussion

In the study where NAA, IAA and IBA hormones and these hormones' five different levels were applied, at the level of 0.01 in terms of root weight and root number, hormone doses, hormone x hormone interactions, at the level of 0.01 among the hormones and hormone x hormone interactions in terms of root length and at the level of 0.05 among the hormone doses, significant differences were determined.

3.1. Root Weight

The effects of NAA, IAA and IBA hormones and these hormones' five different doses on Anatolia sage's root weight are given in Fig. 1 and Table 1. while hormone x hormone doses interactions are given in Table 2. The highest root weight values were obtained from NAA and IAA hormones, and the root weight of cuttings which NAA and IAA were applied to was notable high than those to which IBA was applied. While root weight in cuttings in which hormone was not applied was 1.824 g, significant increases in root weight were

seen with hormone applications. While root weight in the lowest hormone application was 1.822 g, this value was 3.051 in the highest hormone application.

Table 1. Average Results Concerning Root Weight and Root Number and Significance Groups

	Hormones			Hormone doses				
	NAA	IAA	IBA	5	4	3	2	1
Root weight	2.675 a	2.462 a	1.713 b	3.051 a	2.550 ab	2.168 bc	1.822 c	1.824 c
LSD		0.377				0.423		
Root number	41.523 b	71.95 a	43.960b	77.397 a	59.063 b	62.058 ab	32.388 c	28.000 c
LSD		10.473				7.328		

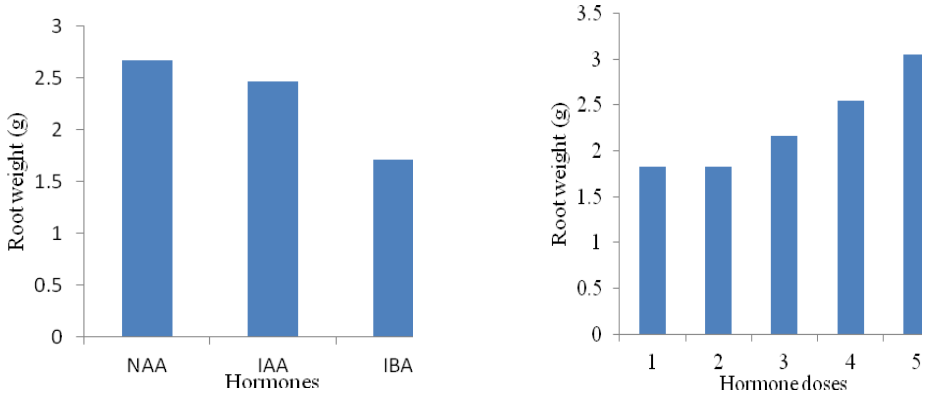

Fig. 1. Root weight average values in different hormone and hormone doses

While the highest root weight was obtained from the highest hormone level, significant differences between cuttings to which hormone was applied and the low dose applications. When the effects of hormone x hormone doses interactions on root weight was examined, it was seen that the highest root weight value was obtained from 240 ppm dose of NAA applcation, which was followed by 300, 400 and 200 ppm doses of IAA. The lowest root weights were obtained from those whcih hormone was not applied to and the low dose applications of IBA and IAA.

3.2. Root Number

The effects of three different hormones and these hormones' five different doses on the root number of sage cuttings are given Fig. 2 and Table 2. Hormone applications and root numbers changed between 44.000-70.750, and considerable root numbers were obtaibed from IAA applications and NAA and IBA applications. Between NAA and IBA applications, no difference was seen in terms of the quality examined. With the increase of hormone doses, significant increases were seen in root numbers.

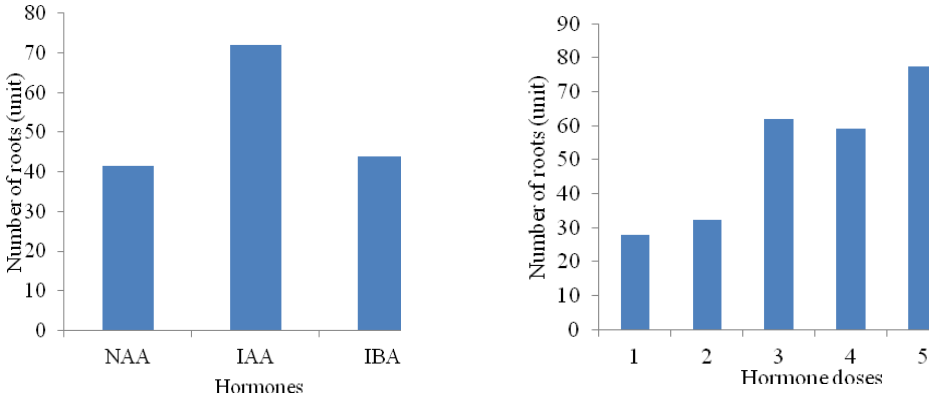

Fig. 2. Root numbers average changes in different hormones and in hormone doses

While the highest root number values (77.397) were obtained from the highest hormone dose application, the lowest root numbers were obtained from cuttings to which hormone was not applied and to which the lowest hormone dose was applied (28.000 and 32.3889). As can be seen from Table 2, the highest root numbers were obtained from 300, 400 and 200 ppm doses of IAA application, and this is followed by 240 ppm dose application of IAA and IBA.

Table 2. Hormone x hormone doses interaction concerning root weight and root number and significance groups

IAA (ppm)	Root weight (g)	Root number (item)	NAA (ppm)	Root weight (g)	Root number (item)	IBA (ppm)	Root weight (g)	Root number (item)
0	2.010 b-e	34.385 ef	0	2.398 bcd	29.900 ef	0	1.065 e	24.183 f
100	1.485 de	29.900 ef	60	2.263 bcd	37.715 cde	60	1.717 cde	35.550 def
200	2.918 b	100.825 a	120	2.138 bcd	36.450 c-f	120	1.450 de	48.900 c
300	2.973 b	91.663 a	180	2.582 bc	38.450 cde	180	2.095 bcd	47.075 cd
400	2.925 b	102.988 a	240	3.992 a	65.100 b	240	2.235 bcd	64.100 b
LSD	0.984	12.693						

3.3. Root Length

The effects of different hormones and hormone doses on root length are given in Fig. 3. and while hormone x hormone interactions are given in Table 4. The longest root was obtained from NAA and IAA applications while the lowest root values were obtained from IBA application. Root lengths changed between 10.487-11.416 cm according to the applied hormone doses, and the highest hormone values were obtained from the highest hormone doses.

Table 3.Average values concerning root length and significance groups

	Hormones			Hormone doses				
	IAA	NAA	IBA	5	4	1	3	2
Root length (cm)	10.498 b	11.734 a	10.454 b	11.416 a	10.862 b	10.828 b	10.487 b	10.806 b
LSD	0.818			0.599				

As can be seen from Table 4, values concerning root length changed between 9.610-12.428. The longest roots were obtained from 60 ppm dose of IAA while the shortest roots were obtained from 200 ppm of IAA. With the dose increase in IBA, it was seen that root lengths increased.

While in hormone x hormone interaction, 11.125 cm root length was measured in the plants to which IAA hormone was not applied, root length in low hormone values diminished, and 240 ppm application gave the same results with those not applied. In NAA application, increases occurred in 60, 120 and 240 ppm applications.

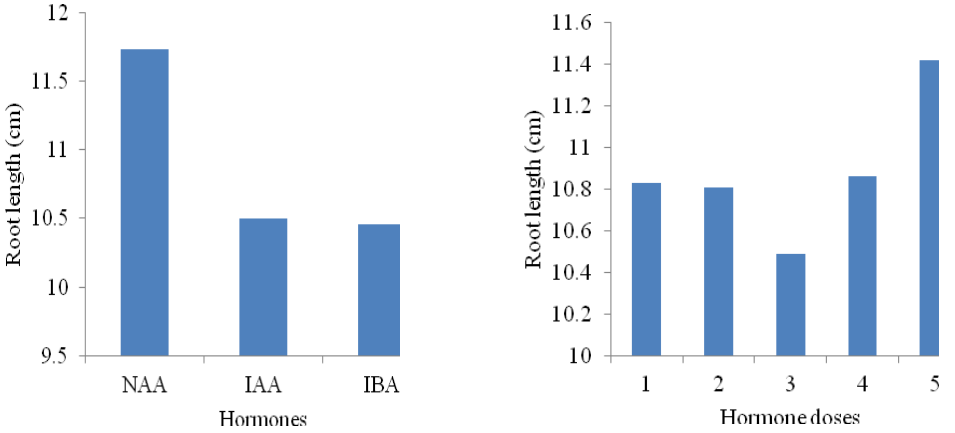

Fig. 3. Average changes in root length in different hormone and hormone doses

In IBA application, especially in 300 and 400 ppm application, notable increases in root length was supplied. The study of [11], [12] and [10] has similarities with our results.

Table 4.Hormone x hormone interaction concerning root length and significance level

IAA (ppm)	Root lenght (cm)	NAA (ppm)	Root length (cm)	IBA (ppm)	Root length (cm)
0	11.125 b-e	0	11.490 abc	0	9.870 fg
100	10.140 efg	60	12.428 a	60	9.850 g
200	9.610 g	120	11.925 abc	120	9.925 fg
300	10.395 d-g	180	10.850 c-f	180	11.300 bcd
400	11.175 b-e	240	11.935 ab	240	11.325 bcd
LSD (0.05)	1.038				

According to the results obtained, IAA application increased root number considerably. While high hormone dose applications caused the notable increase in root weight and root number in all of three hormones, low hormone applications did not affect root length.

References

[1] Ceylan, 1996, Tıbbi Bitkiler II (Uçucu Yağ Bitkileri). Ege Üni. Ziraat Fak. Yayın No:481. Sf. 240-246

[2] Bayram, E. 2001. Batı Anadolu Florasında Yetişen Anadolu Adaçayı(*Salvia fruticosa* Mill)'nda uygun Tiplerin Seleksiyonu Üzerinde Araştırma. Turk J. of Agr. and For.. 25(2001) 351-357 Baytop, T. 1999. Türkiye'de Bitkiler İle Tedavi.Nobel Tıp Kitabevleri. LTD Sf142-144.

[3] Başer, K.H.C. 2002. Aromatic biodiversity among the flowering plant taxa of Turkey. *Appl. Chem.*, Vol. 74, No. 4, pp. 527–545, 2002.,

[4] Özdemir, G. and Sağlam, C. 2009. Sustainable use of medicinal and aromatic plants and employment of women in its production: Case of Kumbağ-Uçmakdere. BENA

[5] Baytop T (1999). Türkiye'de Bitkiler İle Tedavi Geçmişte ve Bugün. Nobel Tıp Kitapevi ISBN975-420-021-1, 98s İstanbul.

[6] Li TSC2006. The range of medicinal herbs and spices. Handbook of herbs and spices CRC Press volume 3:120 Woodhead Publishing Limited Cambridge, England.

[7] Bozan,B., Öztürk, N.,Koşar,M.,Tunalıer,Z.,Başer,C.H.K.,2002. Antioxidant and Free Radical Scavenging Activities of Eight Salvia Species. Chemistry of Natural Compounds 38 (2).

[8] Başer, K.H.C.2000. Production of Salvia oil in Mediterranean countries. Med. and Arom. Plants- Ind. Prof. Sage, the genus *Salvia*. Edited by Spiridon E. Kintzios Vol.14. Harwood acedemic publishers.

[9] Ford YY, Bonham EC, Cameron PS and Blake, HL. 2001. Adventitious Rooting: Examining the Role of Auxin in an Easy and a Difficult-to-root *Plant.* Plant Growth Regulator, 36:149-159.

[10] Tuğrulay, S., Uçar, E., Turgut; K.2006. Rootıng performance of some aromatical plants from lamiaceae The *Labiatae*: Advances in Production, Biotechnology and Utilization 22-25 February 2006 - International symposıum Sanremo, Italy.

[11] Arslan, N.,B. Gürbüz, ve G.Yılmaz, 1995. Adaçayı (*Salvia officinalis* L.)' ında tohum tutma oranı ve çelik alma zamanı ile İndol Butirik Asidin (IBA) gövde çeliklerinin köklenmesine etkileri üzerinde araştırmalar. TUBİTAK Tr. J. of Agriculture and Forestry 19 (1995)83-87.

[12] Ayanoğlu, F. Mert A, Erdoğan C, Kaya A.2002. Propagation of some native grown medicinal plants by stem cuttings Journal of herbs, spices & medicinal plants 2002,9:(4).